How Strong Is Your Tinder Game? Two-Sided Search in Swipe-Based Dating Applications

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Abstract

In today's love market, swipe-based dating apps have a well-established presence, but novel platform features can add significant complexities to the user's search problem in ways that have not been studied in existing literature. This paper formulates a game-theoretic model of two-sided search within swipe-based dating apps, along with an appropriately refined notion of equilibrium. Using numerical methods, I approximate equilibria at the steady-state and perform comparative statics on various model parameters to replicate and explain stylized facts observed in aggregate Tinder data. Finally, agent-based simulations are used to analyse off-path dynamics and discuss how exogenous platform features (such as the matching algorithm and the swiping caps) can be set in a socially-efficient manner.

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2019 – 2022

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1 Introduction

It is widely considered that the search for love is an intricate and complex social phenomenon, and in today's world, swipe-based dating applications seem to only make it trickier. These platforms, best exemplified by Tinder or Bumbble, provide a gameified way of browsing through potential romantic partners by swiping through a stack of suggestions to indicate likes or dislikes, one profile at a time. In the search and matching literature, these fall under the category of decentralized two-sided matching markets with online search (Kanoria and Saban, 2021), emphasising the fact that *a)* both sides of the market are comprised of rational agents, *b)* matches only occur given a double coincidence of wants, and *c)* romantic suggestions are presented in a *sequential* manner to users. These apps thus differ widely from traditional dating sites where users are centrally and statically matched (such as ...), but have come to dominate the modern love market, with Tinder boasting XXX million users as of 2021 and YYY million paid subscribers.

From a theoretical standpoint, these platforms introduce many additional complexities that, due to their novelty, have been sparsely studied in the economics literature, with these falling into two categories: those arising from platform features and those arising from the intrinsic nature of the problem. The first of these refers to platform-specific factors such as suggestion algorithms, matching technologies, swiping caps, and asynchronicity, which are often determined exogenously and pose significant constraints to the way utility-maximizing agents strategise their search process. On the other hand, the generalized problem of search is inherently complex as it involves a dynamic game of incomplete information where, even though the stage interaction is simple, its repetition demands consideration of

Overall, the prevalence of these swipe-based dating apps in modern social interactions, the theoretical complexities they induce, and the largely understudied nature motivated this dissertation. Although many different questions can be asked regarding these platforms, answering these requires a fundamental understanding of how users make decisions in these platforms: to put it simply, *when should a user swipe right?*. This paper will explore the above question in the setting of a swipe-based dating platform where agents on both

formulating a game-theoretic model of two-sided search within these platforms along with a corresponding definition of equilibrium. Using numerical methods, I approximate the steady-state equilibria and perform comparative statics

Points to discuss on introduction

- What is Tinder? (brief)
  - When was it started?
  - What is swiping?
  - How popular it is?
- Why does Tinder pose an interesting economic problem?
  - Stage interaction
  - Platform features: budgets, observability, directed search, asynchronicity
  - Repeated games: curse of dimensionality, beliefs and meta-beliefs
- What and how does this paper study?

- Model of two-sided search with strategic considerations
- Equilibrium refinement, computation, and analysis
- Planner considerations on directed search and budget setting

- What does this paper contribute?
  - First model to address budgeted search in Tinder?
  - First model to combine idiosyncracy and pizzaz
  - Case study for the use of computational techniques in

1.1 Related Work

- Searching and Matching
  - Gale and Shapley (1962), Roth and Sotomayor (1992)
  - Two-sided: Burdett and Wright (1998), Chade (2006), Smith, Adachi
  - **Does not consider budgets**
    * ... important as this is a way for planners to influence outcomes
- Mean-Field Game Theory: Iyer et al. (2014), Gummadi et al. (2013), Jovanovic and Rosenthal (1988)
  - No models on MFG for Tinder
- Modern Dating Apps: Olmeda (2021), Kanoria and Saban (2021)
  - Not models where behaviour is derived from rational utility-maximizing assumptions

2 Theoretical Model

2.1 Setup

- Who are the players?
  - Disjoint sets of men and women in the platform
  - They have attractiveness type $\mu, \omega \in [0, 1]$
  - They do not know (or care) about their own attractiveness.
- What do they do?
  - They get anonymously and sequentially partnered up.
  - To their knowledge, this happens in a random manner.
  - They observe the suggestion's attractiveness
  - They can choose to swipe left or right, thus $\mathcal{A} = \{0, 1\}$.
  - If they both swipe right on each other, they match. Note this doesn't mean they leave.

- What do they know?
  - Equally agents face a cap on the number of right swipes they have
  - B_m for men and
- What are their preferences?
  - Players get no payoffs from not matching, and $u(\mu)$ or $u(\omega)$, where $u(\cdot)$ is increasing, concave, and crosses through the origin.
  - This is evident since users can unmatch with each other, making all matches weakly preffered to non-matching.

2.2 The Dating Market

- Entry flows
- Leaves (including geometric lifetime)
- Masses
- Distribution
- Steady State

2.3 The Search Problem

- Present case for women, then say case for men follows
- Condition on male strategy and steady state
- Present Ex-interim utility maximization
  - Show it reduces to a constant
- Present sequence problem
- Derive Bellman equation
- Prove uniqueness of value function and solution
- Derive solution

3 Equilibrium

3.1 Steady-State Equilibrium

- Define and explain concept of SSE
- Explain computation via least-squares
- Explain main properties (eg. ESS & uniqueness)

3.2 Comparative Statics

- Present CS on individual factors and explain intuitively
- These include: patience, risk aversion, distributions
- Present case of gender disbalance... why is it that men always swipe right?
-

4 Agent-Based Simulations

4.1 Convergence and Dynamics

- Check Mass convergence
- Check distribution convergence
- Relate to ESS
- What about Dynamics??? BR

4.2 Directed Search

- try page rank
- try elo rating
- try v simple RW algo
- Do any of these converge onto GS (note... define gale shapley mathcings)?

4.3 Social Efficiency

5 Conclusion

In this chapter we shall do a reference to an entry in the bibliography, `bibliography.bib`.

What we know of the invention of the flux capacitor is that Dr. Emmett Brown thought of this when hanging a clock in the bathroom. He was standing on his porcelain sink and slipped because it was wet, the resulting hit on the head was apparently a cause to this invention Brown (1955).

5.1 Future Work

The corresponding sketch made on this day has been attached in appendix B.

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A Uniqueness and Existence of Search Problem

B Notation

- Male types μ
- Female types ω
- Strategies $s = (s_m, s_w)$
- CDF's $M(\mu, b)$, $W(\omega, b)$
- Densities $m(\mu, b)$, $w(\omega, b)$
- Discount δ
- Population CDF's F_m, F_w
- Masses N_m, N_w
- Entry Flows λ_m, λ_w
- Tightness $\tau = \min\{\frac{N_w}{N_m}, 1\}$
- Effective discount α